Network Research Group

CIFRE PhD thesis
2016–2019

CIFRE PhD Grant – Smart Mobility & Multi Modality in the Future Complex Urban Environments

Location	Technology & Strategy, Strasbourg (France) ICube Laboratory (UMR CNRS 7357), University of Strasbourg (France)
Supervision	Dr. Stéphane Klein (T&S) Dr. Fabrice Théoleyre (CNRS) Dr. Antoine Gallais (Univ. Strasbourg) Prof. Cristel Pelsser (Univ. Strasbourg)
Ph.D. Grant	CIFRE
Work start date	around Oct. 2016 (depending on the ANRT acceptance)
Contact	reseaux-smartmob@icube.unistra.fr

Context

Our society is facing an unprecedented massive urbanization. At the time of writing, 54% of the world's population lives in urban areas (with an 82% peak in North America), opposed to only 30% in 1950. The obvious (but not nearly trivial!) emerging challenge is how to successfully accomplish a sustainable urbanization at such level and scale. Information and Communication Technologies (ICT) are expected to play a crucial role in the sustainable development of new urban environments. The term Smart Cities has been coined to identify technology-intensive cities which provide the ability to gather, analyze, and distribute information so as to transform services offered to the citizens, improve operational efficiency, and entail better decisions at the municipal level.

Smart mobility aims at making the trips more flowing. In particular, smart cities have now to integrate new actors and new usages :

— a new age will start, with fully autonomous cars accessible on-demand ;
— new entrants are catalyzing the transformation (e.g. Google, uber)
— the needs of developing flexible transportation services
— massive collaborating software solutions to reduce both the CAPEX and OPEX (e.g. blablacar, ubercommute)

Scientific Challenges

A large body of techniques have been developed to compute shortest trips in road or train networks. Similarly, multi-modal transportation planning has been extensively studied in the last decades. However, the development of urban smart areas comes with unprecedented challenges :

1. web 2.0 and now 3.0 is emerging, with intensive digital interactions, virtualizing the physical world. The connection of a so large human communities empower systematic interactions and altruism. How could we exploit these interactions to make the solutions more flexible ?

2. smart cities now integrate a very large collection of smart devices to monitor the traffic, regulate the traffic lights, monitoring the car park occupancy, etc. More and more local authorities develop now opendata strategies, where measures are pushed to the web to be exploited by other actors. How can this huge volume of data be used to design smarter algorithms ? To regulate the traffic, optimizing both the individual (trip time), and global (e.g. pollution) interests ?
3. personalization is now a requirement for most modern systems. Obviously, the proposed trips should be different for a family with a cart and a sportsman or student. Several criteria have to be considered, and the classification must be automatic : a user cannot realistically enter all his preferences for each of his requests.

PhD thesis objective

The objective of the PhD thesis consists in designing a flexible trip planning solution. He will develop new innovative ways to make the system more resilient. He will have to propose a tradeoff between the individual and the global interest. In particular, the candidate will study how to integrate flexible transportation systems (individual cars, bus) to make globally the transportation system more efficient. In particular, he will analyze the tradeoff between the cost (number of buses) and the global interest (average improvement of the transportation efficiency). Finally, he will study how we may avoid congestion in this kind of networks, to balance the load (freight and passengers) to avoid the apparition of car jams, or decreasing the quality of experience. Tools from the network area may be exploited to tackle this challenge.

The codes will be developed in Python / C ++ or other scripting languages. During this project, the candidate will develop his/her expertise in distributed optimization, machine learning, big data, and radio and network contextualization for 5G and self- organization/optimization mechanisms, for both passengers and freight.

Required Profile

The successful student should :
— Be eager to tackle real problems with innovative solutions
— Present good communication skills
— Possess good verbal and written English skills (French is not required)
— Present excellent programming skills in C, knowledge of at least one scripting language
— Holding an MSc in Computer Science is mandatory
— distributed algorithms, complexity
— statistics and data analysis
— Having notions in machine learning techniques would be a plus

Documents required for application

The applicants may send an email to reseaux-smartmob@icube.unistra.fr with the following material :
— a CV and a list of publications
— the grades for the last 3 years (and positions in the final exams)
— a cover letter with your research statement and your motivations
— either 2 letters of reference, or 2 referees who may be contacted directly